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(पहला पुनरीक्षण)

Indian Standard

HIGH CARBON STEEL WIRE RODS — SPECIFICATION

(First Revision)

UDC 669·14-412

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1995

Price Group 2

Wrought Steel Products Sectional Committee, MTD 4

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the darft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council

This standard was first published in 1975. A large quantity of high carbon steel wires is manufactured in India. Some important uses for these wires are : Prestressed concrete wires, steel spring wires, spoke wires, umbrella rib wires, textile industry wires and wires for general engineering purposes. Since carbon steel wire rods, which is the raw material for these wires, a need was felt to review the standard to ensure that the wire drawing industry receive the requisite quality of raw material. The Committee, therefore, decided to revise it with the present practices being followed by the Indian Industry.

In this revision certain items, for example, cold heading quality for fasteners and ball bearings have been deleted as these special qualities will require a separate specification. The other changes made in this revision are as follows:

i) Chemical composition of different grades of material has been modified,
ii) Provision of permissible variation for product analysis has been incorporated,
iii) Dimensional tolerances have been modified,
iv) Limits for maximum surface defects and partial decarburization for grades G and H have been modified,
v) Limits for maximum resolvable pearlite have been incorporated.

For the benefit of the purchaser, an informative Annex A, giving uses of wire rods has been included.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HIGH CARBON STEEL WIRE RODS — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements for high cabon steel wire rods for the manufacture of wires for various purposes.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
228	Methods for chemical analysis of steels
1956 (Part 5) : 1976	Glossary of terms relating to iron and steel : Part 5 Bright steel bar and steel wire (*first revision*)
4163 : 1982	Method for determination of inclusion content in steel by microscopic method (*first revision*)
4748 : 1988	Methods for estimating average grain size of steel (*first revision*)
6396 : 1983	Method for measuring decarburized depth of steel (*first revision*)
8910 : 1978	General technical delivery requirements for steel and steel products

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1956 (Part 5) : 1976 shall apply.

4 SUPPLY OF MATERIAL

General requirements for the supply of material shall be as laid down in IS 8910 : 1978.

5 GRADES

5.1 Steel wire rods shall be of five grades, namely, Grades X, E, F, G and H, according to the chemical composition, surface defects, non-metallic inclusion rating and decarburization. They shall be identified according to their restricted chemical compositions, non-metallic inclusion rating, the permissible depth of surface flaw and also decarburization limit.

5.2 Each grade shall be further classified according to the requirements of various applications in the engineering industries. The grade of wire rod shall be designated by a symbol which shall be a combination of these gradations. These tests, if desired, will be applicable for Grades X, E and F.

Example

Chemical Composition:

Constituent	*Percent*
Carbon	0·35 to 0·40
Manganese	0·40 to 0·60
Silicon	0·10 to 0·25
Sulphur	0·03 *Max*
Phosphorus	0·03 *Max*
Copper	0·12 *Max*
Nickel	0·10 *Max*
Chromium	0·10 *Max*
Maximum depth of surface defects and decarburization	1 percent of diameter
Non-metallic inclusion rating	Class 1
Grade designation	E/35/01/1

6 MANUFACTURE

6.1 The steel shall be manufactured by any process of steel making at the discretion of the manufacturer. It may be followed by secondary refining or vacuum degassing. Steel can be cast into ingots or continuously cast into billets/blooms.

6.2 Sufficient discard shall be made from each ingot to ensure freedom from piping, segregation and other harmful defects.

6.3 During the process of manufacture, the material should be chipped, ground, scarfed or otherwise prepared to remove surface imperfections likely to produce defects in rods. Scales on the wire rod shall be controlled by the manufacture to the minimum.

7 CHEMICAL COMPOSITION

7.1 The ladle analysis of steel when analyzed in accordance with the relevant parts of IS 228 or any other established instrumental/chemical method shall be as given in Table 1. In case of dispute the procedure given in relevant parts of IS 228 shall be the referee method. However, where the method is not given in IS 228 or its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

Table 1 Chemical Composition of Carbon Steel Wire Rods

(*Clause* 7.1)

Constituent, Percent	**Range**	**Grades**				
		X	E	F	G	H
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Carbon	0·35 to 1·00	5*	5*	5*	5*	5*
Manganese	0·30 to 0·90	20*	20*	20*	30*	30*
Silicon	0·10 to 0·35	15*	15*	15*	20*	25*
Sulphur, *Max*	—	0·020	0·030	0·030	0·040	0·040
Phosphorus, *Max*	—	0·025	0·030	0·030	0·040	0·040
Copper, *Max*	—	0·06	0·12	0·15	0·15	0·20
Nickel, *Max*	—	0·05	0·10	0·10	0·12	0·15
Chromium, *Max*	—	0·05	0·10	0·12	0·15	0·15

NOTES

1 Nitrogen should not exceed 0·01 percent, *Max* for grades X, E and F.

2 Stricter specification may be mutually agreed between the manufacturer and the purchaser.

*Acceptable within point range,

P + S For Grade E = 0·055 % *Max*
For Grade G = 0·070 % *Max*

Cu + Ni + Cr For Grade E = 0·25 % *Max*
For Grade F = 0·30 % *Max*
For Grade G = 0·35 % *Max*
For Grade H = 0·40 % *Max*

7.1.1 In case of continuously cast billets, the billet analysis may be taken as ladle analysis.

7.2 Product Analysis

Permissible variation in case of product analysis from the limits specified under **7.1** shall be as given in Table 2.

Table 2 Permissible Variation for Product Analysis of Carbon Steel

(*Clause* 7.2)

Constituent	**Variation Over the Specified Maximum or Under the Minimum Limits, Percent, *Max***
(1)	(2)
Carbon	0·02
Manganese	0·03
Sulphur	0·005
Phosphorus	0·005
Silicon	0·03
Copper	0·003
Nickel	0·003
Chromium	0·003

NOTE — Variation shall not be applicable both over and under the specified limit in several determinations in a heat.

8 CONDITION OF MATERIAL ON DELIVERY

Wire rods shall be delivered in as-rolled condition after suitable controlled cooling.

9 DIMENSIONAL TOLERANCES

Wire rod shall be subject to the size tolerance as given in Table 3.

Table 3 Size Tolerance on Wire Rod

(*Clause* 9)

All dimensions in millimetres.

Diameter		**Size Tolerance, *Max***	**Out of Round, *Max***
(1)		(2)	(3)
Over	Up to and Including		
5·0	12·0	± 0·30	0·45
12·0	16·0	± 0·40	0·60
16·0	—	± 0·50	0·80

10 MECHANICAL PROPERTIES

The mechanical properties shall be as agreed between the manufacturer and the purchaser.

11 SAMPLING AND CRITERIA FOR CONFORMITY

The process of manufacture should be capable of meeting the requirements of surface defects, depth of decarburization, non-metallic inclusion rating and microstructure as per Tables 4, 5, 6 and 7.

11.1 The extent of sampling to be done for meeting these requirements and for certification may be mutually agreed to between the manufacturer and the user.

12 SURFACE DEFECTS

12.1 The finished wire rod shall be cleanly rolled to the dimensions specified. The wire rods shall not have surface imperfections higher than those given in Table 4. In case of decarburized surface defects the depth of defect shall be measured inclusive of decarburization.

12.2 Flaw detector shall be used for certifying maximum permissible surface defect in Grade X as per Table 4.

Table 4 Maximum Permissible Surface Defects

(*Clauses* 11, 12.1 *and* 12.2)

Grade	Maximum Depth of Surface Defects, Percentage of the Diameter
(1)	(2)
X	0·5
E	1·0
F	1·5
G	2·0
H	2·5

13 DECARBURIZATION TEST

13.1 A cross section of the wire rod (transverse) shall be cut and mounted on rounded plastic or alternative material for preparation of the section. After polishing and etching by suitable etchant, the section shall be examined under microscope at 100 magnification. In case a hardness profile is taken to determine the depth of decarburization, the same shall be deemed to commence from the location where the hardness drops to 75 percent of the base value. A minimum of 5 wire rod samples should be analyzed. The maximum limits of partial decarburization shall be as indicated in Table 5. No free ferrite is permissible.

NOTE — In measuring the depth of decarburization in addition to the above a reference may also be made to IS 6396 : 1983.

13.2 The limit of average value of decarburization should be mutually agreed between the manufacturer and the purchaser.

Table 5 Maximum Permissible Depth of Decarburization

(*Clauses* 11 *and* 13.1)

Grade	Limit of Maximum Value of Partial Decarburization as a Percentage of Diameter
(1)	(2)
X	0·5
E	1·0
F	1·5
G	2·0
H	2·5

14 NON-METALLIC INCLUSIONS

14.1 Wire rods shall be free from excessive non-metallic inclusions.

14.2 Non-metallic inclusion when tested according to IS 4163 : 1982 for Grades X, E and F shall not exceed the values given in Table 6.

Table 6 Inclusion Rating

(*Clauses* 11 *and* 14.2)

Inclusion	Class I	Class II
(1)	(2)	(3)
Sulphide	2	1·5
Alumina	2	1·5
Silicate	2	1·5
Globular oxide	1·5	1·5

NOTE — As the applications are quite varied, inclusion ratings other than those specified may be mutually agreed upon including for grades G and H.

15 MICROSTRUCTURE

Controlled cooled material shall have a fine pearlitic structure, the maximum limit of percentage resolvable pearlite at 500 magnification is given in Table 7.

NOTE — Alternatively, the limit of percentage of resolvable pearlitic may be mutually agreed upon between the manufacturer and the purchaser.

Table 7 Maximum Resolvable Pearlite at 500 Magnification Linear Intercept Method

(*Clauses* 11 *and* 15)

Diameter, mm	Resolvable Pearlite, *Max* Percent
(1)	(2)
Up to 8·00	15
Over 8·00	20

16 GRAIN SIZE

If mutually agreed to between the purchaser and the manufacturer, grain size shall be controlled and, when estimated in accordance with IS 4748 : 1988 shall conform to the agreed units.

17 AXIAL SEGREGATION

The method of inspecting axial segregation and the assessment criteria shall be agreed upon at the time of ordering.

18 PACKING

Each coil of wire rod shall be bound and fastened compactly.

19 MARKING

19.1 Each coil of wire rod shall carry a metallic tag which shall be legibly marked with the cast number, grade, size of the wire rod, and manufacturer's name or trade-mark.

19.2 BIS Certification Marking

The material may also be marked with the Standard Mark.

19.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standard Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Foreword*)

USES OF WIRE RODS

A-1 The wire rods of various grades in coil form are used normally for further cold drawing for conversion to produce the following categories of wires:

- Valve spring, spring steel grade III, card clothing wire, SW, PC for BBRV.
- Tyre bead, Grade II spring steel, PC wire for circumferential prestressing (pipes), Stranded PC wire, brush wire,
- Vibrating creed wire, shutter spring, tiller.
- PC single wire, ACSR, cycle spoke, umbrella rib wire, needle wire heald wire, armature binding, Grade 1 spring steel, spring washer.

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This Indian Standard has been developed from Doc : No. MTD 4 (3807).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at Printwell Printers, Aligarh, India